Health Promotion and Chronic Disease Prevention in Canada

Research, Policy and Practice

Volume 35 · Number 6 · August 2015

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Published by authority of the Minister of Health.
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ISSN 2368-738X
Pub. 140441
Journal_HPCDP-Revue_PSPMC@phac-aspc.gc.ca

Également disponible en français sous le titre : *Promotion de la santé et prévention des maladies chroniques au Canada : Recherche, politiques et pratiques*

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Canada

Prevalence and patterns of chronic disease multimorbidity and associated determinants in Canada

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Abstract

Introduction: Multimorbidity is increasingly recognized as a key issue in the prevention and management of chronic diseases. We examined the prevalence and correlates of chronic disease multimorbidity in the general adult Canadian population in relation to age and other key determinants.

Methods: We extracted data from the Canadian Community Health Survey 2011/12 on 105 416 Canadians adults. We analysed the data according to the number of multimorbidities (defined as 2+ or 3+ diseases from a list of 9) and examined the determinants of multimorbidity using regression analyses.

Results: Our findings show that 12.9% of Canadians report 2+ chronic diseases and 3.9% report 3+ chronic diseases. Those reporting 3 or more chronic diseases were more likely to be female, older, living in the lowest income quintile and to have not completed high school. In the overall population, social deprivation is associated with a 3.7 odds of multimorbidity, but when examined across age groups, the odds of multimorbidity were notably higher in middle age, 7.5 for those aged 35 to 49 years and 5.4 for those aged 50 to 64 years.

Discussion: As the proportion of Canadians living with multiple chronic diseases increases, we need to assess chronic disease from a holistic perspective that captures multimorbidity and upstream factors, to facilitate broader and more context-appropriate associations with healthy living, quality of life, health care costs and mortality. Special consideration should be given to the role that social deprivation plays in the development of multimorbidity. Canadians living in the lowest socioeconomic group are not only more likely to develop multimorbidity, but the onset of multimorbidity is also likely to be significantly earlier.

Keywords: multimorbidity, Canada, non-communicable disease, chronic disease

Key findings

- In 2011/12, 12.9% of Canadian adults aged 20 years plus had two or more chronic conditions and 3.9% had three or more.
- Arthritis, mood disorder and/or anxiety, and asthma were the most common chronic conditions and appeared prominently in multimorbidity groupings.
- The prevalence of multimorbidity increases with age, with lower household incomes and with lower education levels within the household.
- As multimorbidity becomes the norm for individuals living with chronic disease, it is all the more important to assess chronic diseases from a holistic perspective rather than from a single-disease–centric approach.

Introduction

About one in three Canadians live with at least one major chronic disease,[1] and this proportion is expected to rise as the population ages and the risk factors for these diseases continue to climb.[2,4] As the leading cause of death worldwide, chronic diseases were responsible for 38 million (68%) deaths in 2012. Moreover, the World Health Organization projects that the total annual number of deaths due to chronic disease will increase to 52 million by 2030.[5] In Canada, heart disease, stroke, cancer, chronic respiratory diseases and diabetes accounted for 62.7% of all deaths in 2011.[6] Having two or more chronic diseases concurrently, referred to as multimorbidity, adds another layer of complexity to their prevention and management, in part because people with multiple diseases are at a greater risk of adverse health outcomes, more frequent hospitalizations and greater health care needs.[7]

Multimorbidity is increasingly recognized as a key public health issue. Despite that, its epidemiology is not well understood. Estimates of the prevalence of multimorbidity vary from 13.1%[8] to 90%[9], largely due to differences in case definitions, data sources and study populations.[10] The most common way to measure multimorbidity is to count whether a person has two or more of a predefined list of chronic conditions.[6] However, the choice of conditions can influence prevalence estimates. For example, Agborsangaya et al.[11] found that 36% of Albertans had two or more chronic conditions, but their definition included obesity, which itself had a prevalence of

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28.1%. Limiting a study sample to certain sub-populations, such as institutionalized populations or older populations, would also affect estimates.[9,12,16]

The main objective of this study was to examine the prevalence of multimorbidity in the adult Canadian population by selected sociodemographic variables and risk behaviours. Our secondary objectives were to examine the prevalence of disease dyads and triads.

Methods

Data source

This study is based on an analysis of the Canadian population aged 20 and older using data derived from the 2011/12 Canadian Community Health Survey (CCHS). The CCHS is a cross-sectional population health survey that includes Canadians aged 12 years and older but not those living in nursing homes or long-term care facilities or on reserves, full-time members of the Canadian Armed Forces, or civilian residents of military bases. The survey was designed to derive estimates at the national and provincial levels and for 110 health regions in Canada. Details about survey methodology are described elsewhere.[17] A multi-stage sample allocation strategy ensures relatively equal weighting to the health regions and the provinces.

Study variables

To identify the prevalence of specific chronic diseases, CCHS respondents were asked about those of their long-term conditions that were "expected to last or have already lasted 6 months or more and that have been diagnosed by a health professional." Each respondent was asked about their demographic and socioeconomic characteristics including sex, age, household characteristics (i.e. number of people in the household, highest level of education, household income) and Aboriginal identity. For our analysis, we assigned a relative measure of socioeconomic status to each respondent based on their reported total household income and household characteristics, according to Statistics Canada's household income adequacy quintiles. We used these quintiles to examine differences between the lowest income level and the highest. The Survey captures behaviours such as smoking (daily or occasional vs. not at all), dietary habits (5 or more servings of fruits and vegetables per day[18] vs. less than 5), leisure-time physical activity (active or moderately active vs. inactive) and obesity (body mass index ≥ 30) based on self-reported information, as well as the risk conditions of high blood pressure and stress (not at all, not very or a bit stressful vs. quite a bit or extremely stressful).[18] These behavioural risk factors for chronic disease were identified through a consultative process between the Public Health Agency of Canada and relevant stakeholders.[19]

Multimorbidity case definition

We defined multimorbidity as having two or more (2+) and three or more chronic diseases (3+) from a list of nine. This definition was established by an expert working group convened by the Public Health Agency of Canada in 2012.[20] The diseases were selected based on their chronic duration, high population prevalence in Canada, significant societal and/or economic impact, and amenability to primary prevention.[20] Based on these criteria, and data availability in the CCHS, the nine diseases we included in this study were arthritis, mental disorder (mood disorder and/or anxiety), asthma, diabetes mellitus, heart disease, chronic obstructive pulmonary disease (COPD, only available for ages 35 years and older), cancer, stroke, and Alzheimer's disease and related dementias. We analysed data using the 2+ and 3+ chronic disease case definitions.

Statistical analyses

The prevalence of multimorbidity for the general population, and stratified by sex, were estimated. Common dyads and triads of diseases were identified within each of the four age groups (20–34, 35–49, 50–64, 65+ years).[21] Data are reported for the top five combinations that accounted for at least 5% of Canadians with multimorbidity within the respective pairing group (dyad or triad) and age group.

Univariate logistic models were used to examine the relationship between multimorbidity and various sociodemographic, health and behavioural risk factors, including current age, sex, household income, household education level, Aboriginal status, area of residence (urban vs. rural), physical activity, fruit and vegetable consumption, smoking status, stress level, high blood pressure and obesity. Odds ratios were used to measure associations and the Wald χ^2 test for statistical analyses. A multivariate model using backward stepwise logistic regression analysis identified factors significantly ($p < .05$) associated with multimorbidity (defined using the more conservative 3+ conditions vs. 2, 1 or 0 conditions). Multivariate analyses were stratified by age to account for effect modification. Chi-square analyses were used to test for trend of physical activity across age groups.

CCHS data were weighted to be representative of the Canadian population, and 95% confidence intervals (CIs) of prevalence estimates and odds ratios (ORs) were calculated using a bootstrap resampling technique (500 replications) for all analyses to account for the complexity of survey design. Statistical analyses were performed using SAS procedure statements (SAS EG, version 5.1, SAS Institute Inc., Cary, North Carolina, US).

Results

Prevalence and distribution of multimorbidity by demographics and risk factors

In 2011/12, 12.9% (95% CI: 12.6–13.2; data not shown) of Canadians aged 20 years and over (n = 105 416) reported having two or more (2+) chronic diseases and 3.9% (95% CI: 3.7–4.1; data not shown) reported having three or more (3+) chronic diseases. Whatever the case definition used (2+ or 3+ diseases), the prevalence of multimorbidity showed similar trends across sociodemographic characteristics and risk factors (Table 1). Of those reporting 3+ diseases, the prevalence of multimorbidity was significantly higher ($p < .05$) in women (4.5% vs. 3.3% for men; OR = 1.3, 95% CI: 1.2–1.4), older Canadians (11.3% of the 65+ year age group vs. 0.4% of the

TABLE 1
Distribution and prevalence of multimorbidity[a] by sociodemographic characteristics (CCHS 2011/12, population aged ≥ 20 years)

	N (unweighted)	% of population (weighted)	Prevalence of 2+ chronic diseases, %	Prevalence of 3+ chronic diseases, %	Crude OR (95% CI)[b]	Adjusted OR (95% CI)[b]
Total	105 416		12.9	3.9		
Sex						
Female	58 972	50.9	15.1	4.5	1.4 (1.3–1.5)	1.3 (1.2–1.4)
Male	46 444	49.1	10.6	3.3	1.0	1.0
Age, years						
20–34	21 390	26.7	3.1	0.4	1.0	1.0
35–49	21 787	27.2	6.5	1.6	4.5 (3.2–6.2)	4.5 (3.2–6.2)
50–64	31 449	27.7	16.4	4.7	13.7 (10.1–18.5)	13.6 (10.1–18.4)
65+	30 790	18.3	31.3	11.3	35.4 (26.5–47.3)	35.0 (26.2–46.8)
Household income quintile						
1 (Lowest)	19 060	19.1	19.8	7.4	5.3 (4.4–6.3)	3.7 (3.1–4.5)
2	21 001	20.2	15.9	5.2	3.7 (3.0–4.4)	2.4 (2.0–2.9)
3	21 871	20.0	12.0	3.5	2.4 (2.0–2.9)	1.9 (1.5–2.2)
4	19 559	20.0	9.6	2.2	1.5 (1.2–1.9)	1.4 (1.1–1.7)
5 (Highest)	21 404	20.7	7.7	1.5	1.0	1.0
Highest household education						
Less than High school	11 784	6.7	30.2	11.6	4.3 (3.9–4.8)	1.8 (1.6–2.1)
High school completed	12 970	10.9	17.1	5.6	2.0 (1.7–2.3)	1.5 (1.3–1.7)
Some post-secondary	3575	4.0	15.6	5.0	1.7 (1.4–2.2)	1.6 (1.3–2.1)
Post-secondary completed	70 222	78.4	10.7	2.9	1.0	1.0
Aboriginal status						
Aboriginal	5081	4.4	17.3	6.6	1.7 (1.4–2.1)	2.7 (2.2–3.4)
Non–Aboriginal	83 483	95.6	13.5	4.0	1.0	1.0
Area of residence						
Rural	29 196	18.0	14.1	4.6	1.2 (1.1–1.3)	1.1 (1.0–1.3)
Urban	76 220	82.0	12.6	3.8	1.0	1.0
Immigration status						
Lived in Canada < 5 years	1281	3.1	2.3	0.5	0.1 (0.0–0.8)	0.3 (0.1–2.1)
Lived in Canada ≥ 5 years	14 025	21.2	11.6	3.4	0.8 (0.7–0.9)	0.7 (0.6–0.8)
Canadian–born	87 448	75.7	13.7	4.2	1.0	1.0
Risk Factors						
High blood pressure	28 734	20.6	30.7	11.6	6.7 (6.1–7.4)	3.2 (2.9–3.5)
Obese	21 442	18.8	20.5	6.9	2.5 (2.3–2.8)	2.7 (2.4–3.0)
Inactive	49 780	48.1	15.4	5.0	2.1 (1.9–2.4)	1.7 (1.6–1.9)
High stress	21 682	23.6	16.8	5.3	1.6 (1.4–1.7)	2.5 (2.2–2.8)
< 5 servings of fruit and vegetables/day	58 732	60.2	12.6	3.6	1.1 (1.0–1.2)	1.2 (1.1–1.4)
Smoker	22 225	21.2	14.1	4.5	1.2 (1.1–1.3)	2.1 (1.9–2.4)

Abbreviations: CCHS, Canadian Community Health Survey; CI, confidence interval; OR, odds ratio.

[a] Multimorbidity defined as 2 or more or 3 or more of the following 9 diseases: asthma, arthritis, chronic obstructive pulmonary disease, diabetes, heart disease, mental disorder (mood disorder and/or anxiety), Alzheimer's disease and related dementias, cancer, and stroke.

[b] For prevalence of 3+ chronic diseases, adjusted for age and sex.

20–34 year age group; OR = 35.0, 95% CI: 26.2–46.8), those living in the lowest income quintile (7.4% vs. 1.5% of the highest income quintile; OR = 3.7, 95% CI: 3.1–4.5), those living in households where the highest education attained was less than high school (11.6% vs. 2.9% of households with post-secondary school education; OR = 1.8, 95% CI: 1.6–2.1), those self-identifying as Aboriginal (6.6% vs. 4.0% of non-Aboriginal populations; OR = 2.7, 95% CI: 2.2–3.4) and those born in Canada

(4.2% vs. 3.4% of immigrants living in Canada for ≥ 5 years; OR = 0.7, 95% CI: 0.6–0.8).

High blood pressure (OR = 3.2, 95% CI: 2.9–3.5), obesity (OR = 2.7, 95% CI: 2.4–3.0), inactivity (OR = 1.7, 95% CI: 1.6–1.9), high stress (OR = 2.5, 95% CI: 2.2–2.8), fewer than five servings of fruit and vegetables per day (OR = 1.2, 95% CI: 1.1–1.4) and smoking (OR = 2.1, 95% CI: 1.9–2.4) were significantly associated with multimorbidity using the 3+ diseases case definition (Table 1).

Of adults aged 20 to 65 years, 2.2% (95% CI: 2.1–2.4) reported 3+ coexisting chronic conditions and 8.8% (95% CI: 8.4–9.1) reported 2+ chronic conditions (data not shown).

Chronic disease prevalence and common multimorbidity combinations

We estimated the prevalence of certain chronic diseases to identify multimorbidity for the overall population. We found that arthritis (17.6%, 95% CI: 17.2–17.9), mood disorder and/or anxiety (11.2%, 95% CI: 10.8–11.5), and asthma (8.1%, 95% CI: 7.8–8.4) were the three chronic conditions most commonly exhibited. We found that women had significantly higher rates of asthma (9.4% vs. 6.7%), arthritis (21.7% vs. 13.3%), COPD (3.4% vs. 2.7%), and mood disorder and/or anxiety (14.1% vs. 8.1%) while men had significantly higher rates of diabetes mellitus (7.8% vs. 6.0%) and heart disease (6.4% vs. 4.6%) (Table 2).

The most commonly observed combinations of chronic diseases within the population varied by age group (Table 3). The disease dyad with highest prevalence was arthritis and mood disorder/anxiety (37.8%, 95% CI: 35.6–40.0) followed by arthritis and heart disease (35.2%, 95% CI: 33.2–37.2) and arthritis and diabetes (35.2%, 95% CI: 33.1–37.3). Arthritis, asthma and mood disorder/anxiety was the most commonly reported triad (15.5%, 95% CI: 13.8–17.1) followed by arthritis, diabetes and heart disease (15.1%, 95% CI: 13.6–16.7) and asthma, arthritis and COPD (14.7%, 95% CI: 13.2–16.2).

Mood disorder and/or anxiety accounted for 51.6% (95% CI: 49.2–53.9; data available on request) of reported multimorbidity in younger Canadians (aged 20–34 years). In those aged 35 years and older, the combinations of diseases begin to show more heterogeneity, with the prevalence of particular multimorbidity combinations decreasing with age. Mood disorder and/or anxiety explained less of the overall multimorbidity burden (25.3%, 95% CI: 24.5–26.1; data available on request) within the older age group. Not surprisingly, the more common or prevalent an individual disease is within the population (see Table 2), the more likely that it contributed to rates of multimorbidity. As a consequence, diseases such as diabetes or COPD contributed more to the multimorbidity burden in the older age groups. It is worth noting that the top five multimorbidity combinations follow the same general trends across sexes, except that the fifth most common disease combination was diabetes and heart disease in men and arthritis and COPD in women (data not shown).

Determinants of multimorbidity (3+ chronic diseases)

After adjusting for all variables in the model, we found multimorbidity to be significantly associated with sex, age, household income, Aboriginal status, physical activity, smoking status, stress level and obesity. Stratification by age suggests that physical inactivity progressively, and significantly as of age 50 years and over, contributes to increases in the prevalence of multimorbidity (Table 4; $p < .001$).

In the younger age group (20–34 years), low income quintile was the only demographic risk factor significantly associated with multimorbidity (lowest quintile adjusted OR = 4.5, 95% CI: 1.3–15.7). Health conditions such as obesity (adjusted OR = 2.7, 95% CI: 1.4–5.2) and high stress (adjusted OR = 2.9, 95% CI: 1.6–5.2) were also significantly associated with multimorbidity.

In the 35- to 49-year age group, low income was once again a significant contributor to

TABLE 2
Prevalence of chronic diseases in the general population and among participants with multimorbidity (2+ or 3+ chronic diseases), (CCHS 2011/12, age ≥ 20 years)

Chronic disease	Overall population		Men		Women	
	N	Prevalence, %	N	Prevalence, %	N	Prevalence, %
Arthritis	25 880	17.6 (17.2–17.9)	8858	13.3 (12.8–13.7)	17 022	21.7 (21.1–22.3)
Mental disorders	12 652	11.2 (10.8–11.5)	4147	8.1 (7.6–8.5)	8505	14.1 (13.6–14.6)
Asthma	9000	8.1 (7.8–8.4)	3163	6.7 (6.3–7.1)	5837	9.4 (9.0–9.9)
Diabetes mellitus	9450	6.9 (6.6–7.1)	4828	7.8 (7.4–8.1)	4622	6.0 (5.7–6.4)
Heart disease	8218	5.5 (5.3–5.7)	4289	6.4 (6.0–6.8)	3929	4.6 (4.3–4.9)
COPD	4701	3.1 (2.9–3.2)	1859	2.7 (2.5–2.9)	2842	3.4 (3.2–3.7)
Cancer	3694	2.5 (0.4–2.7)	1476	2.2 (2.0–2.4)	2218	2.9 (2.6–3.1)
Stroke	1944	1.3 (1.2–1.4)	925	1.3 (1.2–1.4)	1019	1.3 (1.1–1.5)
Alzheimer's and related dementias	634	0.5 (0.4–0.6)	330	0.5 (0.4–0.7)	304	0.5 (0.4–0.6)

Abbreviations: CCHS, Canadian Community Health Survey; COPD, chronic obstructive pulmonary disease.

Note: **Mental disorders are mood disorders and/or anxiety.**

TABLE 3
Prevalence of the most common chronic disease dyads and triads, by age group (CCHS 2011/12, age ≥ 20 years)

Prevalence, % (OR; 95% CI)			
Overall	**Age 20–34 years**	**Age 35–49 years**	**Age 50–64 years**
Disease pairs			
Arthritis and mental disorder (37.8; 35.6–40.0)	Arthritis and mental disorder (79.7; 68.0–91.4)	Arthritis and mental disorder (53.3; 44.7–62.0)	Arthritis and mental disorder (46.9; 42.6–51.20)
Arthritis and heart disease (35.2; 33.2–37.2)	Asthma and mental disorder (78.7; 66.3– 91.0)	Asthma and mental disorder (49.4; 41.4–57.5)	Arthritis and asthma (40.0; 36.0–43.9)
Arthritis and diabetes mellitus (35.2; 33.1–37.3)	Arthritis and asthma (66.2; 52.5–79.9)	Arthritis and asthma (45.3; 37.4–53.3)	Arthritis and diabetes mellitus (35.0; 30.8–39.2)
Arthritis and asthma (34.0; 31.9–36.1)	Mental disorder and heart disease (31.4; 16.3–46.5)	COPD and mental disorder (32.1; 25.0–39.2)	Arthritis and COPD (32.6; 28.8–36.4)
Arthritis and COPD (28.9; 27.0–30.8)	Asthma and heart disease (18.8; 6.8–30.7)	Diabetes mellitus and mental disorder (23.2; 16.9–29.4)	Arthritis and heart disease (28.4; 24.7–32.1)
Disease triads			
Asthma, arthritis and mental disorder (15.5; 13.8–17.1)	Arthritis, asthma and mental disorder (64.2; 50.3–78.2)	Arthritis, asthma and mental disorder (31.3; 24.2–38.4)	Arthritis, asthma and mental disorder (20.4; 17.0–23.8)
Arthritis, diabetes mellitus and heart disease (15.1; 13.6–16.7)	Asthma, heart disease and mental disorder (18.2; 6.3–30.2)	Asthma, COPD and mental disorder (19.2; 13.2–25.3)	Arthritis, asthma and COPD (19.58; 16.19–22.96)
Arthritis, asthma and COPD (14.7; 13.2–16.2)	Arthritis, heart disease and mental disorder (17.6; 4.1–31.1)	Arthritis, COPD and mental disorder (19.0; 12.8–25.2)	Arthritis, COPD and mental disorder (17.2; 13.6–20.9)
Arthritis, COPD and mental disorder (12.0; 10.4–13.5)	Diabetes mellitus, heart disease and mental disorder (10.5; 0.0–21.6)	Arthritis, asthma and COPD (13.3; 8.7–17.8)	Arthritis, diabetes mellitus and mental disorder (16.33; 12.96–19.71)
Arthritis, diabetes mellitus and mental disorder (11.9; 10.5–13.4)	Arthritis, diabetes mellitus and mental disorder (9.5; 0.0–19.0)	Arthritis, diabetes mellitus and mental disorder (13.2; 8.3–18.1)	Arthritis, diabetes mellitus and heart disease (12.1; 9.2–15.1)

Abbreviations: CCHS, Canadian Community Health Survey; CI, confidence interval; OR, odds ratio; COPD, chronic obstructive pulmonary disease; OR, odds ratio.

Notes: **Mental disorders are mood disorders and/or anxiety.**

Only disease combinations with a prevalence of > 5% within each age group are included in the table.

Prevalence measures represent dyad and triad estimates in those with 2+ or 3+ chronic disease multimorbidity, respectively.

multimorbidity (lowest quintile adjusted OR = 7.5, 95% CI: 4.0–13.7) as were obesity (adjusted OR = 2.5, 95% CI: 1.7–3.8); high stress (adjusted OR = 1.7, 95% CI: 1.2–2.4); and smoking (adjusted OR = 2.6, 95% CI: 1.8–3.8).

Among 50- to 64-year-olds, women (adjusted OR = 1.3, 95% CI: 1.1–1.6), low income (lowest quintile adjusted OR = 5.3, 95% CI: 4.4–7.9), and Aboriginal status (adjusted OR = 2.0, 95% CI: 1.5–2.8) were significantly associated with multimorbidity (Table 4). Being inactive emerged as a significant risk factor (adjusted OR = 1.4, 95% CI: 1.1–1.7). Smoking (adjusted OR = 1.5, 95% CI: 1.2–1.8), high stress (adjusted OR = 2.1, 95% CI: 1.7–2.5), and obesity (adjusted OR = 2.24, 95% CI: 1.8–2.7) remained significantly associated with multimorbidity.

In those aged 65 years and over, low income (lowest quintile adjusted OR = 2.5, 95% CI: 1.8–3.5) and Aboriginal status (adjusted OR = 2.4, 95% CI: 1.7–3.3) were significantly associated with multimorbidity as were risk factors such as inactivity (adjusted OR = 1.7, 95% CI: 1.5–2.0), high stress (adjusted OR = 2.1, 95% CI: 1.7–2.5), and obesity (adjusted OR = 1.9, 95% CI: 1.6–2.2).

Discussion

The analyses we present in this report align with identified calls for improvements in measuring multimorbidity to respond to program and policy needs.[22] Unlike comorbidity, which has a primary condition, multimorbidity is the concurrent existence of multiple conditions without an index condition. As mentioned previously, published prevalence estimates of multimorbidity vary widely,[10] likely due to differences in how multimorbidity is defined and the methodology used, including population characteristics, sample size and recruitment methods.[10] Using data representative of the general adult population in Canada, our analysis suggests that, in 2011/12, the overall prevalence of multimorbidity was 12.9% (95% CI: 12.6–13.2) in those who reported having 2+ chronic diseases and 3.9% (95% CI: 3.7–4.1) in those who reported having 3+ chronic diseases.

The strong association between age and multimorbidity is well recognized,[12-14] but some key findings from our study merit attention. First, although multimorbidity was higher in the older population (65+ years), 2.2% of Canadians aged 20 to 65

TABLE 4
Analysis of the association between selected sociodemographic characteristics, behavioural risk factors and multimorbidity[a] (3+ chronic diseases) by age (CCHS 2011/12)

Sociodemographic risk factors	Overall ≥ 20		Age, years			
			20–34	35–49	50–64	65+
	OR (95% CI)[b]	Adjusted OR (95% CI)[c]	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Sex						
Female	1.4 (1.3–1.5)	1.2 (1.1–1.3)	1.4 (0.7–2.8)	1.4 (1.0–2.2)	1.3 (1.1–1.6)	1.0 (1.0–1.2)
Male (referent)	1.0	1.0	1.0	1.0	1.0	1.0
Age group, years						
20–34 (referent)	1.0	1.0				
35–49	4.5 (3.2–6.2)	4.9 (3.4–6.9)				
50–64	13.7 (10.1–18.5)	15.3 (11.2–20.9)				
65+	35.4 (26.5–47.3)	35.6 (26.1–48.7)				
Household income quintile						
1 (Lowest)	5.3 (4.4–6.3)	4.4 (3.6–5.5)	4.5 (1.3–15.7)	7.5 (4.0–13.7)	5.9 (4.4–7.9)	2.5 (1.8–3.5)
2	3.7 (3.0–4.4)	2.7 (2.2–3.4)	2.4 (0.7–7.9)	2.9 (1.5–5.4)	3.2 (2.3–4.4)	1.9 (1.4–2.7)
3	2.4 (2.0–2.9)	2.0 (1.6–2.5)	1.0 (0.2–6.9)	1.9 (1.0–3.8)	2.2 (1.5–3.1)	1.6 (1.1–2.3)
4	1.5 (1.2–1.9)	1.4 (1.1–1.8)	0.8 (0.2–3.1)	1.5 (0.7–3.0)	1.3 (0.9–1.8)	1.4 (1.0–2.1)
5 (Highest; referent)	1.0	1.0	1.0	1.0	1.0	1.0
Highest household education						
Less than high school	4.3 (3.9–4.8)					
High school completed	2.0 (1.7–2.3)					
Some post-secondary	1.7 (1.4–2.2)					
Post-secondary completed (referent)	1.0					
Aboriginal status						
Aboriginal	1.7 (1.4–2.1)	2.1 (1.7–2.6)	1.1 (0.5–2.4)	1.7 (0.8–3.6)	2.0 (1.5–2.8)	2.4 (1.7–3.3)
Non-Aboriginal (referent)	1.0	1.0	1.0	1.0	1.0	1.0
Area of residence						
Rural	1.2 (1.1–1.3)					
Urban (referent)	1.0					
Health and behavioural risk factors						
Inactive	2.1 (1.9–2.4)	1.4 (1.3–1.6)	0.9 (0.4–1.7)	1.0 (0.7–1.4)	1.4 (1.1–1.7)	1.74 (1.5–2.0)
<5 servings/day of fruit and vegetables	1.1 (1.0–1.2)					
Smoker	1.2 (1.1–1.3)	1.6 (1.4–1.8)	2.0 (1.0–4.0)	2.6 (1.8–3.8)	1.5 (1.2–1.8)	1.2 (1.0–1.5)
High stress	1.6 (1.4–1.7)	2.1 (1.1–2.4)	2.9 (1.6–5.2)	1.7 (1.2–2.4)	2.1 (1.7–2.5)	2.1 (1.7–2.5)
High blood pressure	6.7 (6.1–7.4)					
Obesity	2.5 (2.3–2.8)	2.2 (1.9–2.4)	2.0 (1.4–5.2)	2.5 (1.7–3.8)	2.2 (1.8–2.7)	1.9 (1.6–2.2)

Abbreviations: CCHS, Canadian Community Health Survey; CI, confidence interval; COPD, chronic obstructive pulmonary disease; OR, odds ratio.

[a] Multimorbidity defined as 3 or more of the following 9 diseases: asthma, arthritis, COPD, diabetes, heart disease, mental disorder (mood disorder and/or anxiety), Alzheimer's disease and related dementias, cancer, stroke.

[b] Crude odds ratio.

[c] Odds ratio adjusted for sex, age, household education, household income quintile, Aboriginal status, activity level, smoking status, stress, high blood pressure, obesity.

years reported 3 or more coexisting chronic conditions, and 8.8% reported 2 or more coexisting chronic conditions, in keeping with previous Canadian studies.[11]

Second, the association of risk factors and multimorbidity increased with age. However, demographic characteristics such as low income were also significantly associated with multimorbidity irrespective of age. In the overall population, social deprivation resulted in a 3.7 odds of multimorbidity, but when examined across age groups, the odds of multimorbidity were notably higher in middle age, with odds of 7.5 for those aged 35 to 49 years and 5.9 for those aged 50 to 64 years. This differentiation of multimorbidity prevalence in middle age based on social deprivation supports the findings of Barnett et al.[23] who noted that the onset of multimorbidity occurred

10 to 15 years earlier in people living in the lowest socioeconomic conditions. Groups living in lower socioeconomic conditions may therefore have greater clinical management needs earlier in their lives and may live with multimorbidity for longer. Whether the progressive increase in prevalence of multimorbidity with age is due to a concentration of common risk factors, such as high stress or smoking, or due to ecological reasons, such as unemployment and gender inequality, is beyond the scope of our analyses. However, it warrants further investigation, particularly as unemployment, income inequality, physical activity level and stress are preventable risk factors that benefit from multisectoral action.

Third, we noticed patterns in the prevalence of chronic diseases. Arthritis, mood disorder and/or anxiety and asthma, which were the most common chronic conditions overall, were prominent in disease groupings, and were each more significantly prevalent in women. Anxiety and/or mood disorders accounted for over half of reported multimorbidity in younger Canadians (20–34 years). In addition, younger women had higher rates of mental disorders than their male counterparts.

Finally, our finding that arthritis and mental disorder are the most common pairing of multimorbidity supports the findings from a 2012 Canadian study that identified arthritis as a top condition in multimorbidity dyads.[24] Our analysis into common disease dyads and triads underscores the need to further investigate clusters of diseases to inform programs focused on integrated and holistic care.[25]

Strengths and limitations

Although the prevalence of multimorbidity and associated determinants we found are generalizable to the non-institutionalized Canadian population, our study has its limitations. Our results are likely to be subject to recall bias since the data are based on self-reports of clinical diagnosis. The results may also be explained, in part, by the operational case definition used for multimorbidity, namely, the number and type of chronic diseases considered. Fortin et al.[10] suggested that the more diseases considered, the higher the prevalence estimates. Rapoport et al.[26] looked at 22 diseases and reported a higher prevalence of multimorbidity in Canada than did Cazale et al.,[27] who considered only 7 diseases. However, Fortin et al.[10] also noted a threshold effect, with prevalence not further affected when 15 or more diseases were considered. We considered 9 chronic diseases, based on a set of public health criteria and limited to those captured via the CCHS. Finally, given the exploratory nature of our analyses and the multiple comparisons, a type 1 error is likely.

Despite these limitations, our results contributed to understanding the epidemiology of multimorbidity to inform prevention efforts, reduce disease burden and align health care services with holistic patient needs. Traditional, single disease-centric approaches may be increasingly inappropriate given that multimorbidity is becoming the norm for people living with chronic conditions. Rather, an integrated approach that addresses multiple diseases and upstream factors, such as socioeconomic determinants and behavioural risk factors, could have a broad-reaching, systematic effect on a range of outcomes including quality of life, health care costs and mortality.[16,28] Further studies to understand the societal and economic impact of multimorbidity are warranted, although any findings in this area will certainly underline the need for prevention, particularly in tackling the common risk factors and determinants of common chronic diseases.

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Report Summary

Mental Illness in Canada, 2015

Surveillance and Epidemiology Division, Public Health Agency of Canada; CCDSS Mental Illness Working Group; CCDSS Science Committee; CCDSS Technical Working Group

Tweet this article

Purpose of this report

This report, *Mental Illness in Canada, 2015* is the first publication to include administrative health data from the Canadian Chronic Disease Surveillance System (CCDSS) for the national surveillance of mental illness. It features the most recent CCDSS data available (fiscal year 2009/10), as well as trend data spanning over a decade (1996/97 to 2009/10). It is also the first national report to include children and adolescents under the age of 15 years. The data presented within this report and subsequent updates can be accessed via the Public Health Agency of Canada's Chronic Disease Infobase Data Cubes at www.infobase.phac-aspc.gc.ca. Data Cubes are interactive databases that allow users to create tables and graphs quickly using their Web browser.

Mental illness

Mental illnesses are characterized by alterations in thinking, mood or behaviour associated with significant distress and impaired functioning. They result from complex interactions of biological, psychosocial, economic and genetic factors. Mental illnesses can affect individuals of any age; however, they often appear by adolescence or early adulthood. There are many different types of mental illnesses, and they can range from single, short-lived episodes to chronic disorders.

Canadian Chronic Disease Surveillance System

The CCDSS is a collaborative network of provincial and territorial chronic disease surveillance systems, supported by the Public Health Agency of Canada. It identifies chronic disease cases from provincial and territorial administrative health databases, including physician billing claims and hospital discharge abstract records, linked to provincial and territorial health insurance registry. Data on all residents who are eligible for provincial or territorial health insurance (about 97% of the Canadian population) are captured in the health insurance registry; thus, the CCDSS coverage is near-universal. Case definitions are applied to these linked databases and data are then aggregated at the provincial and territorial level before being submitted to the Public Health Agency of Canada for reporting at the provincial, territorial and national levels.

In 2010, the Public Health Agency of Canada expanded the CCDSS to track information on mental illness in the Canadian population. The CCDSS identified individuals as having used health services for a mental illness case if they met a minimum requirement of at least one physician claim or one hospital discharge abstract in a given year, using the mental illness codes in the 9th or 10th edition of the International Classification of Diseases.

The CCDSS may capture individuals who do not meet all standard diagnostic criteria for a mental illness but were assigned a diagnostic code based on clinical assessment. Conversely, the CCDSS does not capture individuals meeting all standard diagnostic criteria for a mental illness who did not receive a relevant diagnostic code (includes those who sought care but were not captured in provincial and territorial administrative health databases and those who have not sought care at all). For these reasons, the CCDSS estimates represent the prevalence of health service use for mental illness rather than the prevalence of diagnosed mental illness.

Key findings

Approximately five million Canadians (or about one in seven people) use health services for a mental illness annually. Although high, the age-standardized proportion of people using health services for that purpose remained stable between 1996/97 and 2009/10 (13.2%-14.2%).

Canadian adults, particularly the elderly, are more likely than children and adolescents to use health services for a mental illness; however, the largest relative increase during the 14-year surveillance period occurred among young adolescents (aged 10 to 14). It should be noted that almost one in four people aged 80 and over use health services for a mental illness, though this trend is likely driven by the inclusion of dementias in the International Classification of Diseases under mental disorders.

Women are more likely than men to use health services for a mental illness, especially those between the ages of 25 to 39 years. A combination of genetic, biological, behavioural and sociocultural factors may explain this difference. On the other hand, boys (under 15 years of age) are more likely to use health services for a mental illness than girls; this is likely driven by certain disturbance of conduct disorders and attention deficit disorder which are known to occur more frequently among boys.

In 2009/10, the age-standardized prevalence of the use of health services for mental illness among those one year of age and older was highest in Nova Scotia (16.8%) and British Columbia (15.1%), and lowest in Newfoundland and Labrador (10.5%), Quebec (11.0%) and the Northwest Territories (11.0%). These jurisdictional variations may reflect differences in the distribution of factors known to affect mental health (from individual to society). However, differences in detection and

treatment practices as well as, differences in data coding, database submissions, remuneration models and shadow billing practices may also play a role.

A higher prevalence of asthma and chronic obstructive pulmonary disease (COPD), and to a lesser degree ischemic heart disease, diabetes and hypertension, was observed among people using health services for a mental illness than among those using services for other diseases or conditions. While the relationship between mental illness and other chronic diseases and conditions remains poorly understood, it is well recognized that people with a mental illness such as depression or anxiety are more likely to have a comorbid chronic disease or condition such as cardiovascular disease, asthma or COPD, and that people affected by a chronic disease or condition, are more likely to experience depression and anxiety.

Future plans

Future CCDSS mental illness work includes but is not limited to: the ongoing collection and reporting of data on mental illness and mood and/or anxiety disorders; exploring the feasibility of developing case definitions for other mental illnesses, such as psychotic disorders; and the development of indicators of mortality.

The full report is available online at http://healthycanadians.gc.ca/publications/diseases-conditions-maladies-affections/disease-maladie/mental-mentale/mental-illness-2015-maladies-mentales/index-eng.php

Other PHAC publications

Researchers from the Public Health Agency of Canada also contribute to work published in other journals. Look for the following articles published in 2015:

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